

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

**Preliminary Draft Staff Report for
Proposed Amended Rule 1171 - Solvent Cleaning Operations**

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TABLE OF CONTENTS

	page
Executive Summary	1
Background	1
Technology Review	3
Legislative Authority	4
Rule Proposal	5
Emissions Inventory	6
Emission Reductions – Current Inventory	7
Cost Analysis	8

EXECUTIVE SUMMARY

Proposed Amended Rule 1171 - Solvent Cleaning Operations, will eliminate the rule exemption for the cleaning of architectural coating application equipment by establishing a sunset date of June 30, 2005 for the exemption. Starting July 1, 2005, clean up solvents used for architectural coating application equipment are proposed to have a volatile organic compound (VOC) content of no more than 25 grams per liter of material. This VOC limit is identical to the 2005 rule requirement for all other coating and adhesive application equipment.

Proposed Amended Rule 1171 will reduce VOC emissions through the use of commercially-available near-zero or zero-VOC solvent formulations (exempt solvents) or development of new cleaning materials and/or technologies. Input from users and case studies conducted thus far demonstrate the effectiveness of these clean up solvents with architectural coatings. Additional testing is currently being conducted to further validate their effectiveness particularly with industrial maintenance coatings, which have been the most challenging to clean.

The 2003 Air Quality Management Plan (AQMP) includes a control measure (CM#2003CTS-07) that seeks to further reduce VOC emissions from various architectural coating categories and clean up solvents used in this industry. Proposed Amended Rule 1171 will implement the clean up solvent portion of this control measure. This rule amendment is expected to achieve VOC emission reduction of 8.39 tons per day from the clean up of architectural coating application equipment.

Other amendments being proposed include removing obsolete rule provisions and adding clarifying language to enhance rule effectiveness.

The proposed amendment to Rule 1171 with respect to architectural coatings is as follows:

- add a sunset date of June 30, 2005 to the exemption for the cleaning of architectural coating application equipment, and establish a VOC content limit of 25 grams per liter of material effective July 1, 2005.

The proposed minor amendments to Rule 1171 for other cleaning categories are as follows:

- modify the exemption language pertaining to clean up solvents with VOC content of no more than 25 grams per liter;
- clarify the table of VOC limits to reflect the most current limits applicable for each solvent cleaning activity; and
- add minor clarifications to rule language.

BACKGROUND

Rule 1171 – Solvent Cleaning Operations, is a key component of South Coast Air Quality Management District's (AQMD) ozone reduction strategy. The rule was originally adopted on August 2, 1991 primarily to reduce VOC emissions from solvent cleaning activities during the production, repair, maintenance, or servicing of products, tools, machinery, and general work areas. Subsequent rule amendments expanded the scope of the rule to cover all solvent cleaning operations at all facilities, and established lower VOC limits for all solvent cleaning categories.

Industries subject to the provisions of the rule include facilities that operate and maintain machinery or must remove organic material as part of the production and maintenance process.

The October 8, 1999 amendment implemented AQMP control measure CM#97ADV-CLNG, and established a two-tiered approach in lowering the VOC content limits for all solvent cleaning activities. The first phase took effect on December 1, 2001 with an estimated VOC emission reduction of 6 tons per day. The second phase, originally projected to achieve an additional 9 tons per day emission reduction, is scheduled to occur on July 1, 2005. Both phases rely on greater use of aqueous cleaning technologies and VOC-exempt solvents, or through development of new cleaning materials and/or technologies.

The last amendment to Rule 1171 in August 2002, however, accelerated the reduction of about 1.94 tons per day of VOC emissions expected in 2005. During the time of the amendment, many available low-VOC materials were already meeting the 25 grams per liter VOC content limit established for the year 2005 for general cleaning activities. As a result of the advancement in solvent cleaning technology, the AQMD lowered the VOC content limit for certain solvent cleaning activities to 25 grams per liter starting January 1, 2003, two and one-half years earlier than anticipated.

As in most solvent cleaning activities, Rule 1171 has established VOC content limits for the cleaning of coating and adhesive application equipment. Such application equipment includes, but is not limited to, spray guns, rollers, and brushes used in wood and metal coatings operations, automotive refinishing, etc. The current VOC content limit in Rule 1171 for such cleaning application is 550 grams per liter of material. By July 1, 2005, the VOC content limit is reduced to 25 grams per liter of material and relies mostly on the development of alternative cleaners using VOC-exempt solvents. However, Rule 1171 currently exempts the clean up of architectural coating application equipment from all provisions of the rule as long as the VOC content of the clean up solvent does not exceed 950 grams per liter of material.

Architectural coatings and clean up solvents represent one of the largest non-mobile sources of VOC emissions in the Basin. Since it would be difficult to perform both coating and clean up operations practically within an enclosure vented to an air pollution control device, the most cost-effective method to control VOC emissions is to reduce the VOC content of the coatings and clean up solvents used. The 2003 AQMP includes control measure CM#2003CTS-07 which seeks to further reduce VOC emissions from various architectural coating categories and thinning and clean up solvents used in this industry.

Proposed Amended Rule 1171 will implement the clean up solvent portion of control measure CM#2003CTS-07 by eliminating the exemption provision in Rule 1171 for the clean up of architectural and industrial maintenance coating application equipment. The proposed amendment will lower the VOC limit for clean up solvents used in this industry to the same level expected in 2005 from other industries' coating and adhesive application equipment clean up. Additional VOC emission reductions will be achieved through the use of near-zero or zero-VOC solvent formulations (exempt solvents) or development of new cleaning materials and/or technologies. In addition, technology assessment will continue as required by the rule in order for staff to assess the progress in technology development, and determine if the 2005 VOC limits can be met. The proposed amendments will also clarify rule intent and remove obsolete rule provisions.

TECHNOLOGY REVIEW

One of the provisions in Rule 1171 requires the AQMD to perform a technology assessment for the 2005 VOC limits for various solvent cleaning categories and report the progress in technology development to the Governing Board by July 1, 2004. In order to support the future limits and to achieve the emission reduction goals of the AQMP, the AQMD contracted with the Institute for Research and Technical Assistance (IRTA) to assess the existing technology and develop low or non-VOC solvent formulations. The study included application equipment used for wood, metal, marine, aerospace, architectural and industrial maintenance coatings, and automotive refinishing. A draft final report has been submitted to the AQMD for review.

A preliminary review of the case studies conducted during the last 2 years indicated that low-VOC solvents can be viable cleaning alternatives. In particular, the study found that low-VOC solvents, such as soy cleaners, and VOC-exempt solvents, such as acetone, acetone blends, and methyl acetate, can effectively remove solvent-borne coatings from coating application equipment. Their effectiveness varies according to the specific applications.

For cleaning applications specific to architectural and industrial maintenance coatings, IRTA worked with two painting contractors to evaluate cleaning alternatives. One of the contractors provides painting services to a retirement community. The company uses both water-based and solvent-borne coatings to paint condominiums, apartments and houses. Plain water is used to remove water-based coatings from the coating application equipment. For solvent-borne coatings, IRTA successfully tested acetone and soy-based cleaners as substitute for lacquer thinner. However, the soy cleaner took longer to clean the coating application equipment.

Another contractor that IRTA worked with applies industrial maintenance coatings to substrates exposed to harsh environments. The company provides coating services to facilities such as publicly-owned treatment works (POTWs) and chemical plants. IRTA worked with the company at one of their POTW sites, and tested alternative cleaners such as acetone and other blends of acetone to remove high-solid coatings from the application equipment. IRTA reported that a blend of acetone and surfactant worked well in removing industrial maintenance coatings including zinc primers, and may be used as substitute for high-VOC solvents. However, the owner of the company indicated that additional testing would be required to make a final determination on the effectiveness of the cleaner. To further explore the potential of the acetone/surfactant cleaner, the AQMD staff has started working with several architectural and industrial maintenance facilities to test the acetone/surfactant blend. The results of the testing will be included in a subsequent report to the Board.

Staff is also aware of an existing facility that uses alternative solvents to clean coating application equipment. Staff recently visited Universal Studios, a motion picture studio and theme park located in the Basin. Architectural and industrial maintenance coatings are periodically applied on various structures in both the studio and the park. The facility uses plain water to remove water-based or water-borne-coatings from coating application equipment. For solvent-borne coatings, acetone is used to clean the application equipment. According to a representative from Universal Studios, acetone has proven to be a good substitute for high-VOC solvents and satisfies all of their cleaning requirements. Although Universal Studios already uses zero-VOC cleaners, the facility has agreed to work with the AQMD in testing other alternative cleaners such as the acetone/surfactant blend to determine its effectiveness as a cleaner.

Recently, the Metropolitan Water District (MWD) began testing of another VOC-exempt solvent, parachlorobenzotrifluoride (PCBTF), to remove solvent-borne coatings. Based on conversations with MWD personnel, the PCBTF initially performed well in removing solvent-borne coatings. However, further testing of the solvent is needed to validate the results. The facility is also working with AQMD in testing the cleaning effectiveness of the acetone/surfactant blend.

In addition, AQMD staff is currently conducting a survey of painting contractors in the Basin in order to determine coating and equipment clean up practices in the field. Preliminary results indicate that VOC-exempt solvents such as acetone are already being used by painting contractors to clean architectural coating application equipment. This initial finding is consistent with the results of IRTA's study on the use of alternative cleaners.

The information discussed in the previous paragraphs show that the use of VOC-exempt solvents and its blends offers a viable alternative to high-VOC solvent cleaners. While the studies are limited to a few facilities, the results can be used as starting point for the development of low-VOC formulations. Spray gun manufacturers contacted by AQMD staff gave no specific solvent recommendation for the clean up of their spray equipment. However, these manufacturers indicated that acetone-based solvents can be used to clean their spray equipment and will not cause damage to the internal parts, e.g., gasket, seals, o-rings, etc.

A recent conversation with a solvent formulator/supplier indicated that the 25 grams per liter clean up solvent for coating application equipment can be readily available by 2005 through the use of VOC-exempt solvents and their blends. Research efforts are on-going in the development and testing of low-VOC cleaners for use in coating application equipment, particularly in the area of industrial maintenance coating applications. Another chemical supplier is reformulating an existing blend of exempt solvents to enhance its cleaning effectiveness.

Solvents that comply with the 25 grams per liter limit in 2005 are currently available and now in use. Staff anticipates a continued increase in the use of readily available compliant solvents to meet the 2005 VOC requirement. In addition, staff is confident that the trend towards low-VOC solvents will continue and that more compliant cleaning materials will be available when the new VOC limit takes effect in 2005.

LEGISLATIVE AUTHORITY

The California Legislature created the South Coast Air Quality Management District (AQMD) in 1977 (The Lewis-Presley Air Quality Management Act, Health and Safety Code Section 40400 et seq.) as the agency responsible for developing and enforcing air pollution control rules and regulations in the South Coast Air Basin (Basin). By statute, the AQMD is required to adopt an Air Quality Management Plan (AQMP) demonstrating compliance with all state and federal ambient air quality standards for the Basin [California Health and Safety Code Section 40460(a)]. Furthermore, the AQMD must adopt rules and regulations that carry out the AQMP [California Health and Safety Code Section 40440(a)].

RULE PROPOSAL

The following is a summary of the proposed amendments to Rule 1171:

I. Architectural Coating-Related Amendment**Remove the exemption for architectural coating application equipment, subparagraph (h)(2)(H)**

Staff is proposing to eliminate the rule exemption provision in section (h)(2)(H) for the clean up of architectural coating application equipment. Staff's proposal will establish a sunset date of June 30, 2005 for this specific exemption. Starting July 1, 2005, the cleaning of architectural coating application equipment, such as paint spray guns, rollers, brushes, etc. will now be subject to the 25 grams per liter VOC content limit established for the solvent cleaning category "Cleaning of Coatings or Adhesives Application Equipment", as required in subparagraph (c)(1)(C).

Most, if not all, companies are using water to remove water-based or water-borne coatings from coating application equipment. Staff does not expect any change in this cleaning method. For solvent-borne coatings, staff is aware of facilities that are currently using VOC-exempt solvents or its blends to remove architectural coatings from their coating application equipment. Other facilities are continuing to test alternative cleaners with promising results. In addition, the results of case studies on a few facilities applying architectural and industrial maintenance coatings indicate that blends of VOC-exempt solvents can be used to substitute for high-VOC clean-up solvents.

Staff believes that the proposed compliance date provides sufficient time for the affected industry to try out low-VOC materials or exempt solvents that would best suit their cleaning requirements. In addition, staff's proposal still allows solvent suppliers and/or formulators enough lead time to develop effective and safe compliant materials.

II. Minor Clarifications Affecting Other Categories**1) Amend the Table of VOC Limits, paragraph (c)(1)**

The table of VOC limits is being modified to reflect the most current VOC limits applicable for each solvent cleaning activity. These limits took effect on January 1, 2003. Obsolete VOC limits are being proposed for deletion. All future limits remain unchanged.

2) Modify exemption language, subparagraphs (h)(1)(A) and (h)(1)(B)

The rule exemption in section (h)(1)(A), that applies to solvent cleaners containing no more than 50 grams of VOC per liter of material, expired on December 31, 2002. Staff is proposing to delete rule language pertaining to this exemption. In addition, the exemption language in (h)(1)(B) is being modified to clarify that only solvents containing no more than 25 grams of VOC per liter of material are exempt from all provisions of the rule, except (c)(1), Solvent Requirements. This is consistent with the VOC limits for Clean Air Solvents.

3) Clarify exemption for vapor degreasers, subparagraph (h)(2)(A)

Staff is modifying rule language to clarify that the rule exemption provided in section (h)(2)(A) applies to all vapor degreasers, and is not limited to open-top vapor degreasers.

EMISSIONS INVENTORY

Staff uses a methodology developed by CARB to estimate VOC emissions associated with the use of clean up solvents in architectural and industrial maintenance coatings operations. This methodology assumes a certain amount of clean up and thinning solvent usage for every gallon of solvent-borne coatings sold. Architectural coatings are coatings applied to stationary structures and their accessories, to mobile homes, pavements, or curbs. Industrial maintenance coatings are high performance coatings formulated for and applied to substrates in industrial, commercial, or institutional situations exposed to extreme environmental conditions, such as immersion in water, chronic exposure to corrosive agents, repeated heavy abrasions, etc. Architectural coatings do not include aerosol coating products.

During the last several years, CARB has conducted a survey of manufacturers of architectural and industrial maintenance coatings. The latest survey, conducted in 2001, requested for year 2000 sales information from coating manufacturers for different coating categories. The survey collected information such as annual sales in gallons, vehicle technology (solvent-borne or water-borne), component description (single or multi-component), VOC content, etc., for each of the coating categories.

The results of the survey indicated that the total amount of coatings sold in the state in 2000 was 108,035,870 gallons. Eighty four percent (90,771,505 gallons) of the total coatings sold were water-borne coatings, with solvent-borne coatings accounting for 16% (17,264,365 gallons) of total sales. The total amount of coatings sold in the state was apportioned to the different counties using population density. Based on the 2000 Census data, the total population share for counties in the South Coast AQMD area is about 46%. Using these data, the following shows the breakdown of coatings sold in the South Coast AQMD area as follows:

Total Water-borne Coatings Sold in the State in 2000 = 90,771,505 gallons

AQMD Population Density Share = 0.46

AQMD Share of Water-borne Coatings Sold in 2000 = (90,771,505 gal) x (0.46)
= 41,754,892 gallons

Total Solvent-borne Coatings Sold in the State in 2000 = 17,264,365 gallons

AQMD Share of Solvent-borne Coatings Sold in 2000 = (17,264,365 gal) x (0.46)
= 7,941,608 gallons

CARB currently uses sales information obtained from the survey to determine emissions inventory for clean up and thinning solvents used in architectural coating application equipment. The clean up materials used to remove coatings from architectural coating application equipment depend on the type of coating applied. Water-borne coatings are generally removed using tap

water; therefore, it can be assumed that there are no VOC emissions associated with the removal of water-borne coatings from architectural coating application equipment.

For solvent-borne coatings, CARB estimates the emissions of Total Organic Gases (TOG) based on the assumption that 1 pint of thinner is used as clean up and thinning solvent for every gallon of solvent-borne coating sold. It is assumed that the amount of coatings sold is equal to the amount used. In addition, CARB has indicated that most of the thinner volume (1 pint thinner per gallon of solvent-borne-coating coating sold) is used for clean up of the coating application equipment. The CARB's 1998 Architectural Coating Survey gathered information on recommended thinning practices. The results from this survey indicated that the amount of recommended thinning solvent is small, and represents about 1% of the total solvent volume used for clean up and thinning activities. Preliminary results from AQMD's painting contractors' survey indicate that the volume of clean up solvent used is about 1 pint per gallon of solvent-borne coatings applied.

CARB estimates that the average TOG emission factor for the clean up solvent is 770 grams per liter or about 6.4 pounds per gallon. Reactive Organic Gases (ROG) emissions are calculated by multiplying the TOG emissions by the appropriate Fraction of Reactive Organic Gases (FROG). CARB has estimated FROG to be about 0.9652. Using these data, the VOC emissions in 2000 resulting from the clean-up of architectural coating application equipment in the South Coast AQMD area are calculated as follows:

$$\begin{aligned}
 \text{2000 VOC Emissions} &= [(\text{Solvent-borne Coatings in gal/yr}) \times (1 \text{ pint/gal}) \times (\text{TOG in lbs/gal}) \times (\text{FROG})] / [(8 \text{ pints/gal}) \times (2000 \text{ lbs/ton}) \times (365 \text{ days/yr})] \\
 &= [(7,941,608 \text{ gal/yr}) \times (1 \text{ pint/gal}) \times (6.4 \text{ lbs/gal}) \times (0.9652)] / [(8 \text{ pints/gal}) \times (2000 \text{ lbs/ton}) \times (365 \text{ days/yr})] \\
 &= 8.40 \text{ tons per day}
 \end{aligned}$$

To determine current VOC emissions inventory for clean up of architectural coating application equipment, the baseline (2000) emissions are projected to year 2003 using the assumed AQMP cumulative (2000-2003) growth factor of 3.3 %, equivalent to an average annual growth factor of 1.1%.

$$\begin{aligned}
 \text{2003 VOC Emissions} &= (8.4 \text{ tons/day}) \times (1.033) \\
 &= 8.68 \text{ tons per day}
 \end{aligned}$$

**Total VOC Emissions in 2003:
(Architectural Coating Application Equipment)**

8.68 tons/day

EMISSION REDUCTION – CURRENT INVENTORY

The VOC emission reduction expected in 2005 resulting from the use of low-VOC solvents for clean up of architectural coating application equipment is derived using the 2003 VOC emissions

inventory, average solvent VOC, and the proposed VOC limit of 25 grams per liter. The emission reduction calculation is presented below:

$$\begin{aligned}\text{Average Solvent VOC} &= (\text{TOG}) \times (\text{FROG}) \\ &= (770 \text{ g/l}) \times (0.9652) \\ &= 743 \text{ g/l}\end{aligned}$$

$$\begin{aligned}\text{VOC Emission Reduction} &= (8.68 \text{ tons/day}) \times [1 - (25/743)] \\ &= 8.39 \text{ tons/day}\end{aligned}$$

**Total VOC Emission Reduction in 2005:
(Architectural Coating Application Equipment)**

8.39 tons/day

The 1999 amendment to Rule 1171 (CM#97ADV-CLNG) established VOC limits in 2005 for certain solvent cleaning activities, resulting in emission reductions equivalent to 9 tons per day in 2005. The proposed VOC limits for the clean up of architectural coating application equipment will provide additional VOC emission reduction of over 8 tons per day in year 2005.

The year 2005 VOC emissions inventory for clean up of architectural coating application equipment is determined by applying the emission reduction expected from the 2005 VOC limit. Table 1 summarizes the projected VOC emissions inventory for architectural coating application equipment.

Table 1 – Projected VOC Emissions Inventory

	2000 Emissions Inventory (tons/day)	2003 Emissions Inventory (tons/day)	2005 ¹ Emissions Inventory (tons/day)
Architectural Coating Application Equipment	8.40	8.68	0.29

¹ Reflects inventory after reduction

COST ANALYSIS

Cost-effectiveness, expressed in terms of dollars per ton of pollutant reduced, is defined as the cost to comply with the new regulatory requirements. Determination of cost-effectiveness is required by section 40440(c) of the California Health and Safety Code. Costs can include equipment, materials, energy, waste disposal, or any other costs associated with meeting new regulatory requirements.

This cost analysis section compares the total cost of the replacement solvents with the currently used solvent cleaner. Staff does not anticipate any additional equipment, energy, or waste disposal cost to comply with the proposed amendment.

The following table shows the costs of clean up solvents based on data provided by solvent suppliers and retail outlets. Staff used the solvent average costs for estimating the cost of the proposed amendment.

Name of Solvent	Price Range Per Gallon	Average Cost Per Gallon
Acetone	\$4 - \$8	\$6
Acetone/PCBTF Blend	\$18 - \$25	\$21
Current Cleaner (Thinner)	\$2-\$8	\$5

Staff used the latest CARB survey data to determine the amount of clean up solvent used in year 2000 for architectural coating application equipment.

$$\begin{aligned}
 \text{Clean up Solvent in Year 2000} &= [(\text{Solvent-borne Coatings in gal/yr}) \times (1 \text{ pint/gal})]/(8 \text{ pints/gal}) \\
 &= [(7,941,608 \text{ gal/yr}) \times (1 \text{ pint/gal})]/(8 \text{ pints/gal}) \\
 &= 992,701 \text{ gal/yr or } 2,720 \text{ gal/day}
 \end{aligned}$$

A growth factor of 3.3% (consistent with the 2003 AQMP) was used to estimate solvent usage in year 2003.

$$\begin{aligned}
 \text{Clean up Solvent in Year 2003} &= (2,720 \text{ gal/day}) \times (1.033) \\
 &= 2,810 \text{ gal/day}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total Cost of Current Cleaner} &= (2,810 \text{ gal/day}) \times (\$5/\text{gal}) \\
 &= \$14,050/\text{day}
 \end{aligned}$$

From the 2001 CARB survey of coating manufacturers, solvent-borne architectural coatings represent about 75% of total solvent-borne coatings sold in the state. Industrial maintenance coatings account for the remaining 25%. Based on information available on existing and potential use of VOC-exempt solvents in the clean up of coating application equipment, staff assumes that acetone will be used as replacement solvent to remove solvent-borne architectural coatings. Staff assumes a 10% usage increase due to the higher vapor pressure of acetone as compared to the current solvent cleaners.

The volume of replacement solvent for use in solvent-borne architectural coatings is:

$$(2,810 \text{ gal/day}) \times (0.75) \times (1.10) = 2,318 \text{ gal/day}$$

The cost of replacement solvent (acetone) for solvent-borne architectural coatings is:

$$(2,318 \text{ gal/day}) \times (\$6/\text{gal}) = \$13,908/\text{day}$$

Based on information provided by a solvent formulator and coating manufacturers, staff assumes that a blend of acetone and PCBTF can be formulated to remove solvent-borne industrial

maintenance coatings. Assuming a 10% usage increase due to acetone's higher vapor pressure, the volume of replacement solvent for use in solvent-borne industrial maintenance coatings is:

$$(2,810 \text{ gal/day}) \times (0.25) \times (1.10) = 773 \text{ gal/day}$$

The cost of the replacement solvent (acetone/PCBTF blend) is:

$$(773 \text{ gal/day}) \times (\$21/\text{gal}) = \$16,233/\text{day}$$

$$\begin{aligned} \text{Total Cost of Replacement Solvents} &= \$13,908/\text{day} + \$16,233/\text{day} \\ &= \$30,141/\text{day} \end{aligned}$$

$$\begin{aligned} \text{Cost Increase} &= \text{Cost of Replacement Solvent} - \text{Cost of Current Cleaner} \\ &= \$30,141/\text{day} - \$14,050/\text{day} \\ &= \$16,091/\text{day} \end{aligned}$$

$$\begin{aligned} \text{Cost Effectiveness} &= \text{Cost Increase}/\text{Emission Reduction} \\ &= \$16,091/\text{day}/8.39 \text{ tons/day} \\ &= \$1,918 \text{ per ton of VOC reduced} \end{aligned}$$

Cost-Effectiveness for Year 2005 Limits = \$1,918 per ton of VOC reduced